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Consumer-Driven Innovation: A Photography Case Study

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Consumer-Driven Innovation: A Photography Case Study

by

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Abstract

Consumer-Driven Innovation: A Photography Case Study

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The effects consumer-driven innovation can have on an industry can be difficult to quantify. In this thesis I seek to highlight their existence and underscore their influence by observing the historical impact of numerous innovations on modern technology and society. Using the photography industry as a case study, I will show how successful companies leverage consumers to increase profits and technological development. Companies unable or unwilling to adapt will struggle to maintain profits and become insignificant in the market place. It is also important to consider the enablement of customers by these manufacturers. Advancements in the primary industry as well as supporting industries can lead to variability in market growth and often stimulate societal changes. As consumer innovators progress towards production, it is increasingly important that manufacturers adapt and redefine their market presence. Consumers are a powerful force and represent more than financial capital. My research shows that creative companies can harness consumer energy and find opportunities in the intellectual capital of the crowd.

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Chapter 1: Introduction

RESEARCH QUESTION

How do consumers drive innovation in technological markets? The answer to this question is difficult to quantify; however, we have numerous examples to show that consumers do, in fact, have a role in the innovation process. Due to the scope of this issue, I will be using the photography industry to discuss the realities of consumer-driven innovation.

It is also important to discuss the effect that this, and other, innovations have had in the market. Therefore, I also pose the question, how does the enabling of consumers to use high-tech products affect society? While some of these effects may seem obvious in your interactions with people and devices, we often don't question the origins of the technology. This thesis will investigate several technological advances in photography and discuss the role they currently play in society.

Lastly, I feel it is also important to discuss one additional question. What happens when innovation turns into production? Answering this questions ties together both the innovation and enabling concepts. The Do-It-Yourself, or DIY, community is flourishing and cannot be ignored in our discussions.

WHY IS THIS IMPORTANT?

Consumer-driven innovation is not just a phenomenon worth observing, it is an opportunity. Companies can learn how to leverage the intellectual capital of their consumer base and provide better products and services. It is important to note that this thesis is not about how to implement the business changes needed to involve the consumers in the innovation process; however, it will point out the reality of this situation.

As technology continues to change it is important to reflect on how consumers are taking advantage of the provided capabilities. Customers often use technology in ways that it was not originally intended to be used. This is not always a bad thing and can often provide valuable feedback on customer desires.

Likewise, observing the trends in the DIY communities can provide information about features customers like and point out gaps in the retail market. This is particularly true in the photography world as a significant part of the market is comprised of hobbyists with limited funds, creative imaginations, and a willingness to invest time.

I chose photography as my case study for several reasons, but believe the overarching concepts can be applied to most industries. A key element was that photography has of a century of data to analyze; I thought this was important as I sought to understand the interaction between consumers and manufacturers. Another motivation was the relevance of photography to a wide consumer base as most people interact with some form of photography in their daily lives. Most important was my passion for the topic and interest in the field.

OVERVIEW

The remainder of this thesis will be divided into four sections. The first will discuss the history of photography highlighting significant consumer innovations. I will discuss the influence these consumer-driven innovations have had on the art, science, and practice of photography both at inception and in modern photography.

Next, I will discuss the ways in which the availability of high-tech products and services has shaped modern photography. The decreased prices and improved quality of photographic equipment has had a noticeable impact on our society. Coupling the

advancements in hardware/software with the current social networking trends truly highlights the effect innovation can have on an entire society.

I will then take a more engaged approach as I discuss the Do-It-Yourself paradigm. I feel the best way to research this topic is to immerse myself into the community. I will discuss my experiences and findings as I learn from a wide range of photographers. I will also display the results from my experiments of "doing it myself."

Lastly, I will summarize the results of my research and encourage expanding the concepts discussed and applying them to other industries. I will discuss any significant takeaways and show how my findings support these. I will also make suggestions about any additional research I believe might benefit the successful use of these concepts.

Chapter 2: Consumer-Driven Innovation

OVERVIEW

Consumer-driven innovation has always been around, but its impact is on the rise. Inter-customer communication as well as communication between consumers and companies is soaring. This increased communication is amplifying the voice of consumers and increasing their ability to impose change in products and services. Bruce Nussbaum does a great job of summarizing the reality of the situation:

> As customers become producers and take more and more control of the design of their products and services, the revolution (and make no mistake, it is a serious change in power and that is a revolution) they are generating is bound to unnerve those on the losing end. Companies that "get it" and begin to integrate consumer input into the actual making of stuff and experiences will find enormous opportunities. Those that don't will lose and get mad.[1]

All change requires growth and adaptation. Customers must find ways to effectively articulate what they want and need, and suppliers must find ways to respond to that. "It is a consumer's market and technology is changing the dynamics of the buyer-seller interface. The dynamics between manufacturers, retailers, and consumers has tilted in favor of the consumer."[2] Bornemann's observation points out how critical technology is as these changes occur. He also concludes that the balance of power has shifted to the consumer. While technology, including social networking, may have helped consumers grab the upper hand, it is important to note that consumers had a distinct impact in the products we use today, even before their voices were so clearly united.

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[1] Nussbaum, Bruce; *NussbaumOnDesign*

[2] Bornemann, Thomas; *Consumer Driven Innovation Age*

For this reason, I would like to start this chapter out by looking at the history of photography and its innovations. I will pause on several innovations that were either heavily influenced by, or a direct result of, consumers practicing the art and science of photography. Most of these innovations are either still in use today, or had a lasting impact on modern photography, both in terms of products and services.

INNOVATION TIMELINE

We will start the timeline with the invention of photography. The term "photography" was first introduced by Sir John Frederick William in a paper he wrote in 1839. This is not, however, the beginning of the timeline. To properly discuss the beginning of photography, we must break down the two initial components and discuss their corresponding innovations.

The first requirement for photography is optics. The optical predecessor for photographic equipment and techniques was the Camera Obscura. This dark box, or room, includes a pinhole where light from an external scene is passed and reproduced on a surface. These principles stem from ancient times, but were first clearly defined and tested by Abu Ali Al-Hasan Ibn al-Haytham as documented in his Book of Optics written in early 1000AD.[3] While the camera obscura continued to evolve and became small and portable, they still did not have the ability to retain images – this was going to require further innovation.

The other requirement for photography is chemical in nature. While several people were experimenting with chemicals darkening under exposure, it was Professor Johann Heinrich Schulze that was credited with the discovery that silver nitrate darkened

[3] Kelley, D.H. & Milone, E. F.; *Exploring Ancient Skies: An Encyclopedic Survey of Archaeoastronomy*

upon exposure to light, not heat, in 1727.[4] This creation of the first photo-sensitive compound was crucial in the development of modern photography.

It is unclear who actually took the first picture, but based on current research it was likely either Thomas Wedgwood or Joseph Nicéphore Niépce. Both men seemed to have taken photographs that were drawn by light but quickly disappeared. Niépce is credited with the first permanent photograph ever taken. The pewter plate containing the first photograph was acquired by the University of Texas and is displayed at the Harry Ransom Center. The photograph was taken in 1826 and required an exposure time of at least eight hours.[5] Niépce's photograph was featured in the Life magazine "100 Photographs That Changed the World" book – a sample of the image he captured can be seen in Figure 1.

[4] Leggat, R.; A History of Photography
[5] Flukinger, R.; *The First Photograph*

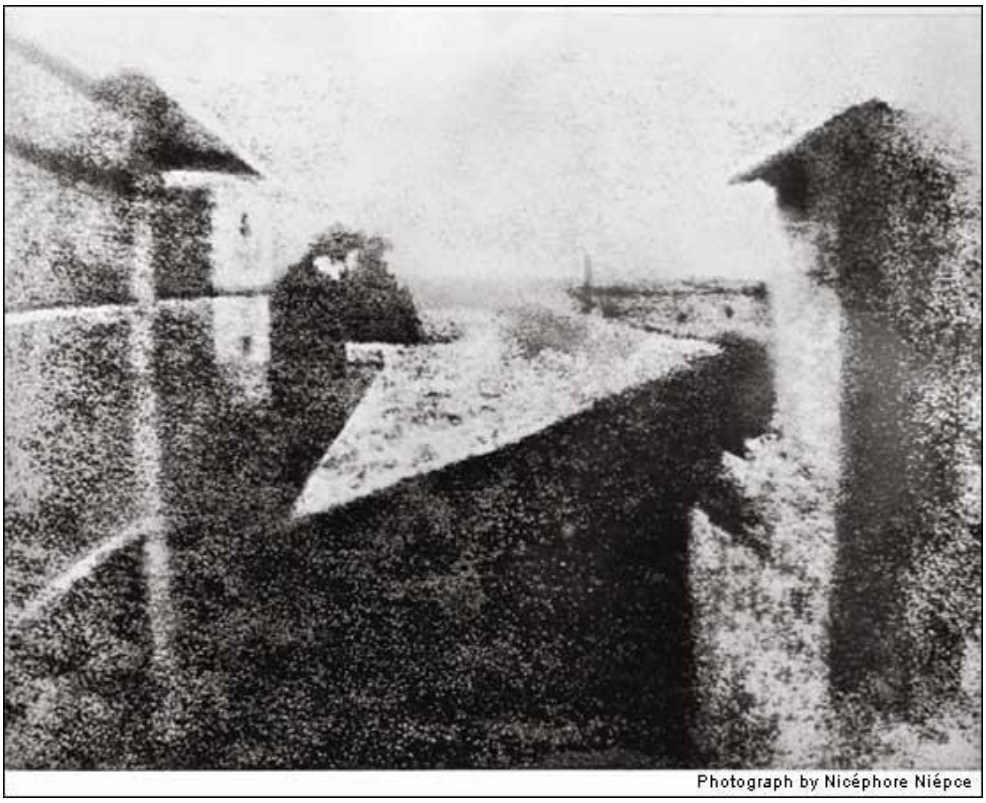

Figure 1: Representation of first photograph: *View from the Window at Le Gras* (Halstead, D.; *Life*)

While this photograph may not be as interesting as many others, it represents the innovative concept of combining the required optics and chemical processes to permanently capture a drawing created solely by light. This marks the beginning of photography and forever changed the world.

For the use of photography to become more practical, the eight hour exposure requirement had to be shortened. Niépce teamed up with Louis Daguerre and began working on a more practical photographic method. Though Niépce died prior to completion, Daguerre continued to refine the process. In 1839 he registered a patent in Britain for a process which reduced the exposure time to around thirty seconds – this process became known as Daguerreotype.

Images created by the Daguerreotype process were direct positive images. Therefore, if more than one copy was required, two cameras had to be used concurrently. This issue was explored by William Fox Talbot at the same time that Daguerre was refining his process. Talbot recognized a key consumer flaw in the work of Niépce and Daguerre, while single instances ensured uniqueness, consumer feasibility required simpler reproduction of captured images.

Talbot accomplished this by creating the Calotype process, which produced a negative image from which many positives prints could be made. This process was hugely significant and would become the method of choice, shaping photographic processes in the centuries to come. While Talbot did not patent his Calotype process until 1841, he responded to Daguerreotype in 1839 by releasing the first negative he had created on paper dated 1835. A positive print made from this negative is shown in Figure 2.

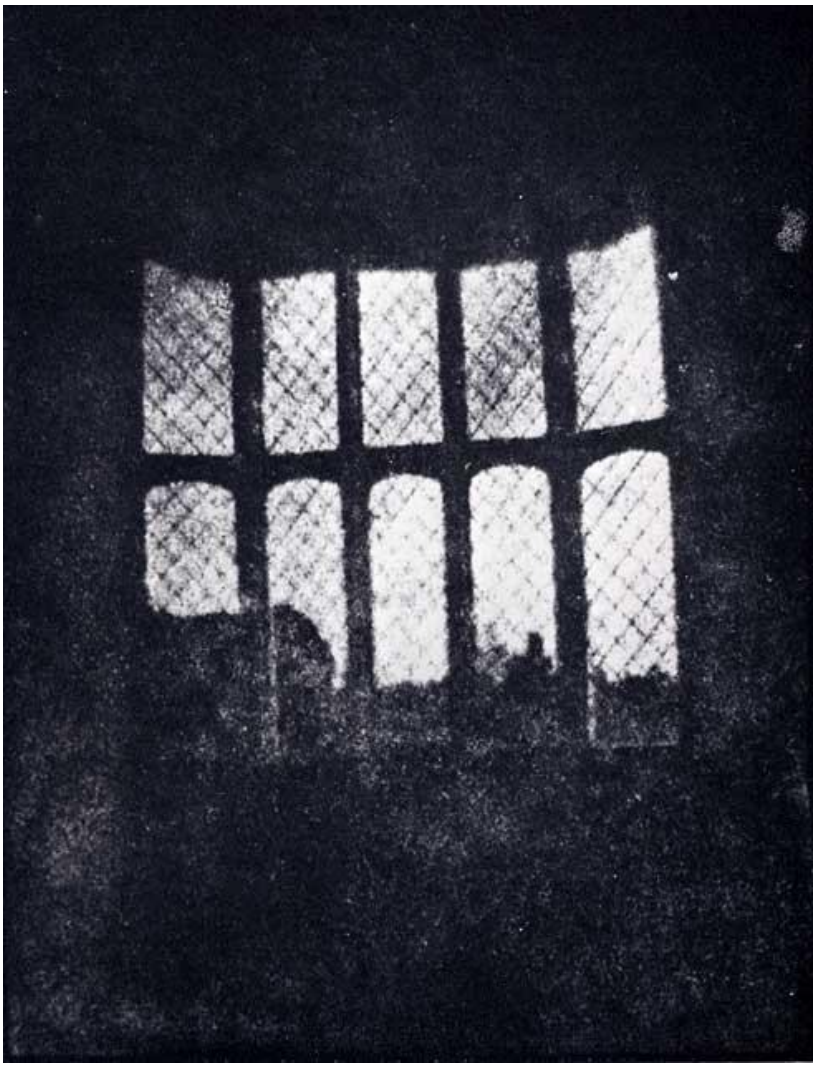

Figure 2: Print made from oldest negative in existence: *Latticed Window at Lacock Abbey* (Stubbs, P.; *Latticed Window*)

By the end of 1843, photography had made great strides and showed signs of a technology that would last the ages. The positive/negative process allowed for multiple copies of images, and exposure times were under five minutes for Calotype and around one minute for Daguerreotype. In 1840 Alexander Wolcott filed for the first patented photographic invention in the US, a Daguerreotype camera. In Figure 3 you can see the patent model for Wolcott's camera. By 1843 photography was being used for portraits in

the studio started by David Hill and Robert Adamson; also, the first advertisement with a photograph was made in Philadelphia.[6]

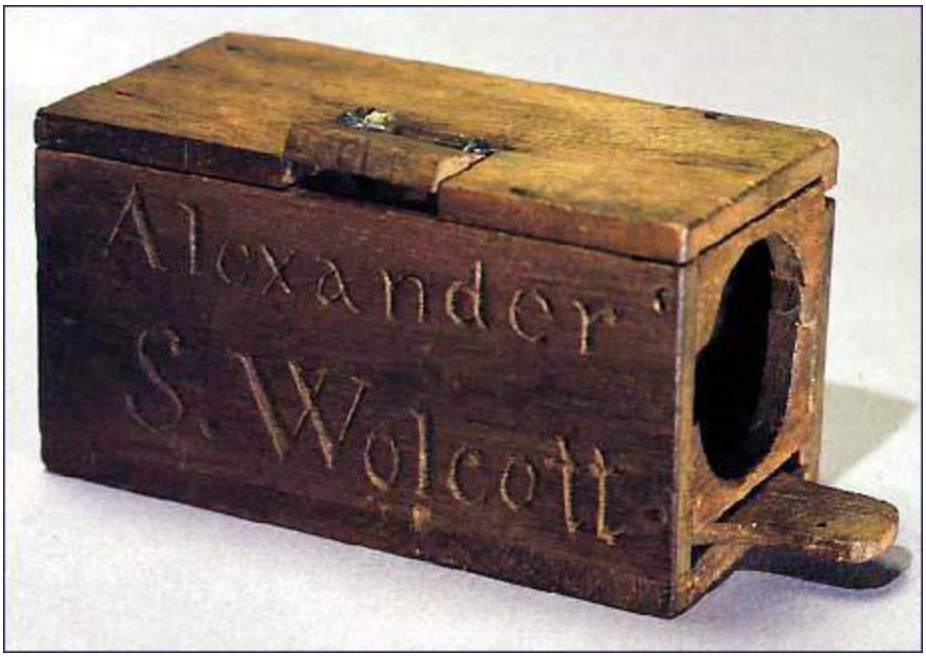

Figure 3: Patent model for a Daguerreotype camera (Burgevin, D.; *Wolcott Camera*)

As the technology continued to develop, consumers continued to demand more from this science. The equipment was highly customized and the process was expensive. While exposure times had been cut dramatically, they were still quite long for photographing humans. In 1851 Frederick Scott Archer cut straight to the consumer demands by introducing wet plate collodion photography. This process was much cheaper, had exposure times of only seconds and also improved photographic resolution. The collodion process greatly increased the feasibility and accessibility of photography to the general public. Unlike several other photography pioneers, Archer was not a

[6] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*

scientist, he was a sculptor, a consumer of the technology who demanded more and created an innovative process that would be used for several decades.[7]

Photographic innovations continued over the next decade, but the next consumer-driven demand was met in 1861 by James Clerk Maxwell – color photography.[8] While his three-color method was crude, it worked and opened the door to color enhanced photographs. The first color photograph taken, by Thomas Sutton, using his method is shown in Figure 4 and is of a tartan ribbon.

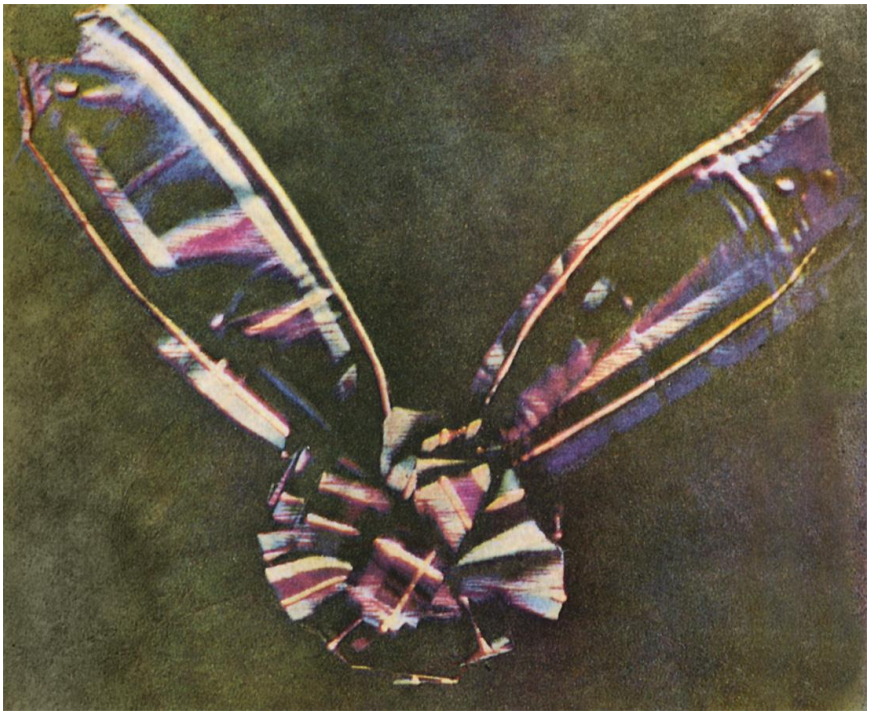

Figure 4: Tartan Ribbon, the first color photograph (Coote, J.; scanned from *The Illustrated History of Colour Photography*)

While color photography continued to be refined, work was going on in other areas of interest in photography. In 1871, Richard Leach Maddox, a photographer and

[7] *Encyclopædia Britannic;Frederick Scott Archer*
[8] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*

physician, advanced the collodion process by inventing the dry plate silver bromide process. Maddox had noticed illness due to the chemicals used in the collodion process as pictures had to be developed why the chemicals were still wet. He sought to advance the technology with an alternative and developed dry plates. Dry plate technology, once again, drastically affected the world of photography by offering several advantages including the ability to buy and sell commercially made dry plates. Also, negatives no longer required immediate development and camera sizes began to shrink dramatically. Another benefit was the substantial increase in recording speed from several seconds, to 1/25th of a second.[9] This increase in speed made handheld photography, or snapshots, viable.

With these increases in the speed of still photography, people started to wonder about the possibility of motion photography. An English photographer named Eadweard Muybridge took consumer innovation to another level as he sought to answer a popular question: "Are all four of a horse's hooves off the ground at the same time during a gallop." Muybridge set up several cameras and used a thread to allow the horse to trigger the shutter release as it passed. The images were developed and a zoopraxiscope was used to view this early version of a motion picture.[10] In Figure 5 we can see that all four hooves are off the ground at the same time.

[9] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*
[10] Wikipedia; *Eadweard Muybridge*

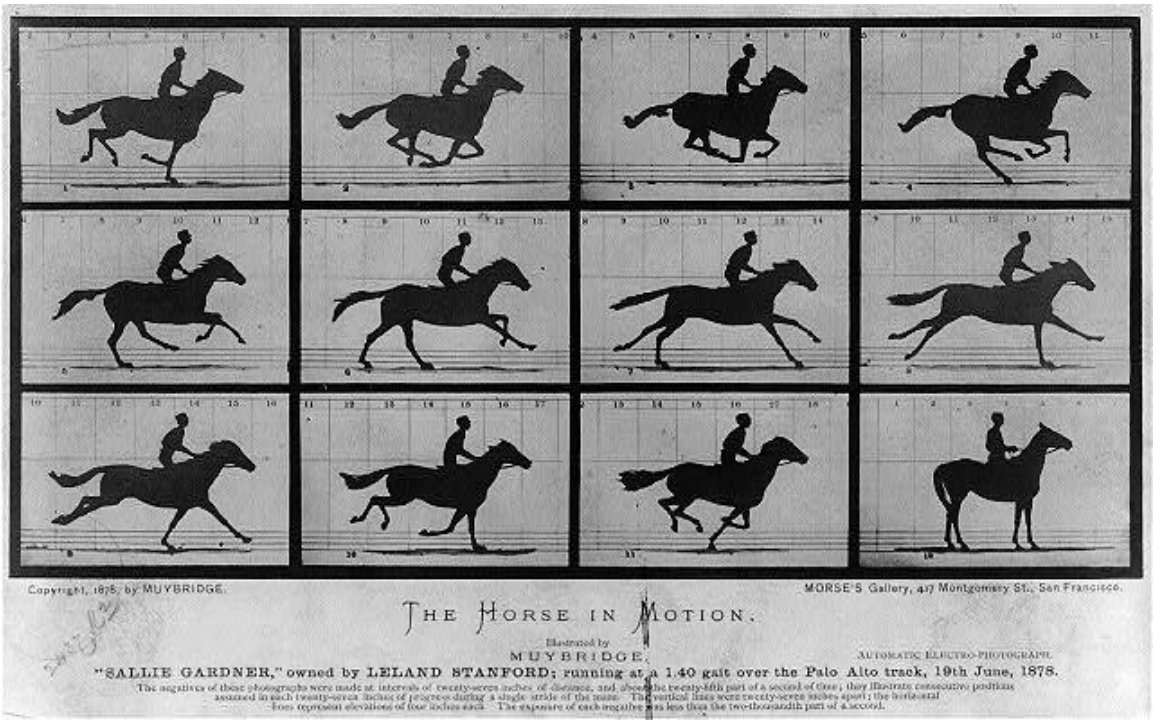

Figure 5: The Horse In Motion (Muybridge, E.; *The Horse in Motion*)

Leveraging the new dry plate technology, we saw a high school dropout photographer turn entrepreneur in 1880 as George Eastman started his dry plate manufacturing company. He was an advocate for amateur photographers, like himself, and sought, "'to make the camera as convenient as the pencil.'"[11] Eastman's work continued and he looked to replace the glass with a more flexible and lighter medium. In 1883 he shook up photography by announcing film in rolls.[12] He began with paper and introduced the Kodak camera using a paper roll in 1888. By 1889 Eastman had innovated further and created what we refer to as film.[13] He also released the Kodak No. 1 which resembled the Kodak camera but used film and established the first easy to use camera.

[11] Kodak; *George Eastman*
[12] Kodak; *George Eastman*
[13] *History of Cameras*

As Eastman continued to work on his film and cameras, another inventor, Thomas Edison, took an interest in expanding the motion picture capabilities. Edison took a roll of Kodak film and split it adding transport perforations and creating 35mm film in 1889.[14] This would become the standard for motion pictures and is still in use today. By 1891 Edison had a patent for a kinetoscopic camera and the kinetoscope exhibition device shown in Figure 6.

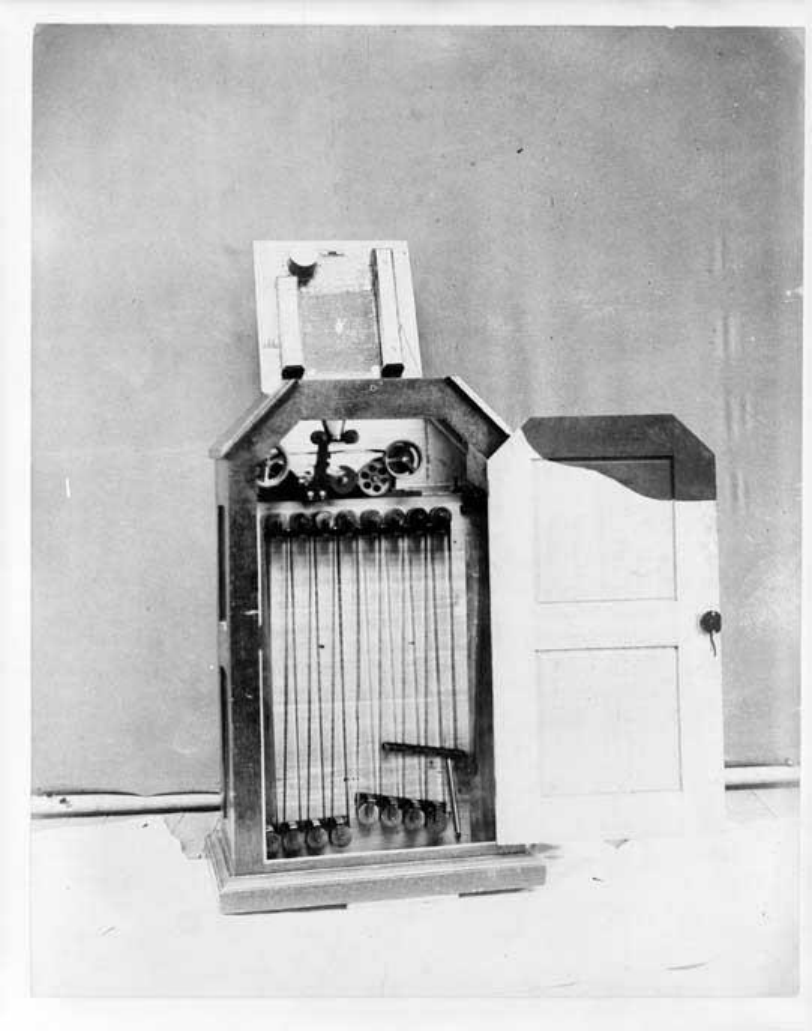

Figure 6: Kinetoscope (Edison, T.; *History of Edison Motion Pictures*)

[14] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*

Though large strides had been made in the world of photography, consumer-driven innovation continued to thrive and further develop photographic technology. Underwater photographer Louis Boutan noted the need for a flash contained in a bulb. This innovation was realized by Frenchman Boutan-Chauffour in 1893 for Boutan.[15] This flash was still fairly primitive, but it altered the course of flash photography.

Altering the course of motion picture in 1895 was Auguste and Louis Lumière with their introduction of the cinematograph.[16] Previous devices required people to watch film reels individually; the cinematograph was a film camera which also served as a projector. Projection of motion film is still used today and was a huge breakthrough for consumers of the capture/projection device and cinematographic audiences.

George Eastman continued to listen to consumer demands and introduced several innovative cameras. In 1898 he met the portability needs of many consumers with the introduction of his Folding Pocket Kodak. A few years later, in 1900, he released the Brownie camera which was mass-marketed and would turn out to be one of the most popular series of camera ever.[17] There are numerous versions of the Brownie camera, but one of the earliest models is shown in Figure 7.

[15] Carter, R.; *Boutan-Chauffour Flash Bulb*
[16] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*
[17] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*

Figure 7: No. 1 Brownie (Mangum, W.; *No. 1 Brownie*)

The 1920's brought three major innovations in the photography timeline. MIT professor Harold Edgerton invented the xenon flash lamp allowing for strobe photography.[18] Also, another major camera manufacturer entered the consumer market as Ernst Leitz introduced the first high quality 35mm camera under the well-known name, Leica.[19] The introduction of the Leica system not only increased the quality of consumer cameras, but also greatly advanced the world of photojournalism. The third innovation was not consumer developed, but was consumer driven both in terms of safety and usability – the modern flashbulb. Flash powder was dangerous and difficult, if not impossible, to use in many situations. General Electric (GE) invented the first commercially available, modern flashbulb mitigating nearly all of those concerns.[20]

[18] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*
[19] Greenspun, P.; *History of Photography Timeline*
[20] Carter, R.; *1920s*

By the 1930's, many of the companies we currently know for their photographic products and services had been formed, such as: Kodak, Nikon, Fujifilm, Canon, Pentax, etc… These companies did not derail consumer innovation, but did, and still do, provide a commercial level of deployment of innovative technologies. Motion picture was advanced with both Technicolor and later Kodachrome technology. Also introduced in the 1930's were the first photoelectric light meter, and the first production 35 mm single-lens reflex (SLR) camera, shown in Figure 8.[21][22]

Figure 8: Kine Exakta (Frizziero, M.; *Kine Exakta*)

Though not a direct innovation to technology or service, I wanted to mention the formation of a group of photographers that influenced the art of photography. The group 'f/64' was formed in 1932 and consisted of several of the world's most well known

[21] Greenspun, P.; *History of Photography Timeline*
[22] Ollinger, J.; *Electrophot M-S*

photographers, including Ansel Adams and Imogen Cunningham.[23] This group sought to fly in the face of the then popular pictorialism movement. Instead, they promoted precise, unaltered images of natural objects – see Figure 9. This innovation in style would lead to supporting technological innovations showing how consumers can effect changes by using available equipment in unique ways.

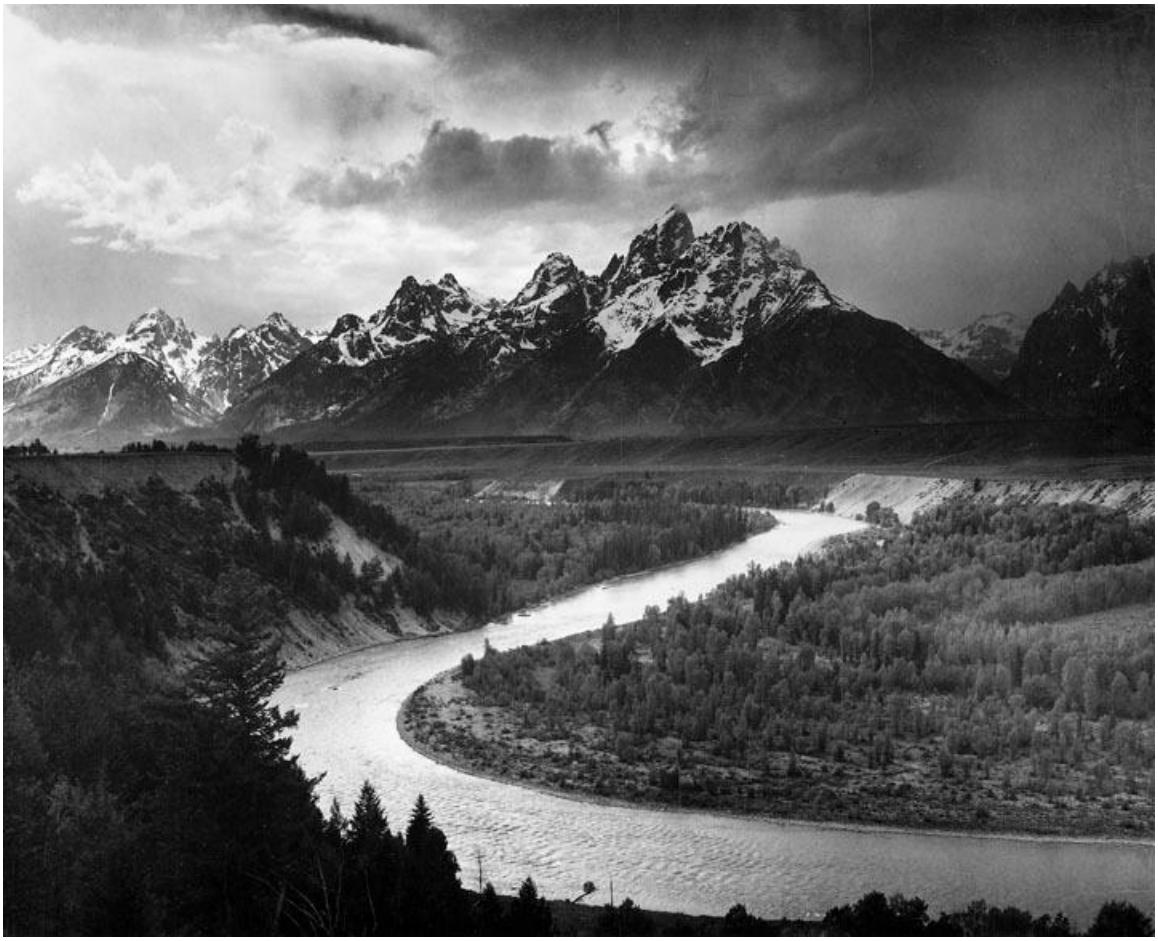

Figure 9: "The Tetons – Snake River" (Adams, A.; *The Tetons – Snake River*)

[23] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*

Film-based technology had energized the world of photography, but consumers still demanded more and Kodak was there to meet the demand of color negative print film in 1942 with the introduction of Kodacolor. Medium-format photography was also given legs in the 1940's as Hasselblad introduced the first commercially available medium-format SLR camera. Additionally, Dennis Gabor is credited with the invention of holography in the 1940's; though not normally used in traditional photography, he went on to win a Nobel Prize in Physics for this work. Perhaps one of the most interesting innovations in the 1940's was the first Polaroid instant black and white camera.[24] When it comes to photography, including modern photography, most consumers want instant feedback after a picture is taken – Edwin Land provided that. An image of the first B&W Polaroid instant camera can be seen in Figure 10.

Figure 10: Polaroid Model 95 (Rochkind, M.; *First instant-picture camera*)

[24] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*

Many of the innovations in the 1950's were made by companies seeking to provide many of the consumer-demanded technologies into a single camera. These are seen with the introduction of the Leica M and the Nikon F camera systems. The 1950's also saw the first digital image produced on a computer. Russell Kirsch and his team at the National Institute of Standards and Technology (NIST) produced the image shown in Figure 11 by taking a picture of his infant son and scanning it into a computer.[25] This innovation not only impacted traditional photography, it also had large implications to areas such as satellite and medical imaging.

Figure 11: First Digitally Scanned Photograph by Russell Kirsch (Frater, J.; *Top 10 Incredible Early Firsts In Photography*)

[25] Frater, J.; *First Digitally Scanned Photograph*

Camera developments continued in the 1960's as Kodak released the inexpensive Instamatic series, and Pentax released its Spotmatic 35mm SLR, offering Through-The-Lens (TTL) exposure metering. Polaroid was enjoying the success of its camera line and met consumer demands by introducing the first color instant film. Also, the Calypso camera was created to meet the underwater photography needs of marine explorer Jacques-Yves Cousteau. The design was acquired by Nikon who created the popular Nikonos camera series specifically designed for underwater use.[26]

Electronics were growing in the 1970's and this included their presence in photography. Konica sought to save photographers from their blurry pictures by introducing the first mass-production autofocus camera – the Konica C35 AF.[27] Canon introduced the first SLR camera with a microprocessor, the Canon AE-1, which gained a huge market penetration with several millions sold. Researchers also worked to create digital imaging techniques and equipment. Fairchild Semiconductor released the first image forming Charge-Coupled Device (CCD) chip, a technology still used by many cameras today. More importantly, in 1975, Kodak engineer Steve Sasson leveraged the CCD work and built the first CCD digital still camera. His work was revolutionary in the world of photography and he was later awarded the National Medal of Technology and Innovation by US President Barack Obama.[28]

As digital photography was in its infancy, consumers were still looking for faster, easier ways to develop and print the pictures they had taken. This was met by a technological development, but more importantly to consumers, a photographic service innovation. In the late 1970's, companies like Noritsu were selling small developing and

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[26] Greenspun, P.; *History of Photography Timeline*
[27] Rochkind, M.; *Konica C35 AF - 1977*
[28] AFP; *Obama rewards digital camera, microprocessor inventors*

printing systems, or "minilabs", to retailers.[29] This allowed on-site photo servicing, increasing the feasibility of amateur photography.

The 1980's brought many items consumers were dying to get their hands on to the commercial space. Consumers had been using motion picture cameras, most notably the Super 8, for years, but the 1980's saw the first consumer video camera, shown in Figure 12. They also saw the first digital electric still camera as well as the first "still video" camera.[30] Pixar also introduced digital image processing starting the ongoing ethical debate around image manipulation.[31] The 1980's also saw the first megapixel camera sensor as well as the introduction of the still popular Canon EOS system.[32] For the many consumers still using film, the DX coding innovation on film canisters would allow cameras to automatically select the correct film speed further automating the photographic process and making it more amateur-friendly.[33]

Figure 12: Sony Betamovie BMC-100P (Ha, P.; *All-TIME 100 Gadgets*)

[29] Wikipedia; *Minilab*
[30] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*
[31] Bellis, M.; *Photography Timeline*
[32] Calcagno, G., & Nikolva, I.; *History of Photography Timeline*
[33] *20 Years of Photo Innovation*

Both video and still photography continued to flourish in the 1990's, as did the innovations. One of the most interesting consumer innovations came from Thomas Knoll, a graduate student, and his brother John. They began by working on software to expand image display capabilities and ended up writing one of the most well known image manipulation programs in the world – Photoshop. While most of the initial code was started in the late 1980's, the software was sold to Adobe and the first version was released in 1990 for the Apple Macintosh.[34]

Apple would be part of another significant innovation in the 90's as they met consumer demand by releasing the first consumer digital camera, shown in Figure 13.[35] There were also several innovations that supported photography; such as lithium batteries and carbon-fiber tripods.[36] When it comes to consumer photography, these tangential products are a large source of consumer enablement.

Figure 13: Apple QuickTake 100 (Ha, P.; *All-TIME 100 Gadgets*)

The introduction of the Nikon Coolscan portable film scanner and the Epson Photo EX printer also impacted the consumer production/publishing process by reducing

[34] Story, D.; *From Darkroom to Desktop—How Photoshop Came to Light*
[35] Ha, P.; *All-TIME 100 Gadgets*
[36] *20 Years of Photo Innovation*

costs and increasing consumer abilities. While geared for professionals, Nikon also released the D1 camera in the late 1990's. The Nikon D1, shown in Figure 14, was the fastest high quality digital SLR camera to sell for under $5,000.[37] This was a tipping point in digital photography for professionals, and eventually all photographic consumers.

Figure 14: Nikon D1 (Pomeroy, A.; *Nikon D1*)

By the 21st century, photography consumer voices were heard and camera developers worked hard to move their products into the digital world. Canon first released the Canon EOS D30, an easy-to-use digital SLR with a price around $3,000. The D30 was a midrange camera targeting the *prosumer* market – non-professionals wanting more than traditional consumer products offer. A few years later consumer

[37] *20 Years of Photo Innovation*

demands were finally answered with the Canon EOS 300D, the first digital SLR under $1,000.[38] Currently, Canon has several digital SLR cameras from entry-level to professional, with prices ranging from $550 to $7,000.[39] The 21st century also saw the introduction of the increasingly popular camera phone.[40]

SUMMARY

The innovation timeline for photography shows us how important the consumer role is in the development and sustainment of an industry. While many of the innovations in the timeline were consumer driven, several were actually consumer created. We can also see that the importance of the consumer held through the breadth of photography, including still and motion, film, video, and digital. In addition, photographic services, such as one-hour in-store photo labs, were driven by consumer innovations and demands.

Those companies that were able to use consumer and corporate innovations as well as customer feedback to adapt their business remained successful. Companies like Kodak released products like the PhotoCD and discontinued production of film cameras when it was clear that the digital format was here to stay. Unfortunately, many companies were unable to sustain and prominent companies like AgfaPhoto and Polaroid found themselves filing for bankruptcy.[41]

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[38] *20 Years of Photo Innovation*
[39] Canon; *Digital SLR Cameras*
[40] Greenspun, P.; *History of Photography Timeline*
[41] Greenspun, P.; *History of Photography Timeline*

Chapter 3: Customer Enabling

OVERVIEW

As we saw in the previous chapter, the innovation timeline was littered with inventions and improvements. We can appreciate what an important role consumer's play in the development and direction of the technology, but what about the role the seller plays? In this chapter I will further explore the relationship between the customer and the merchandiser by focusing on customer enablement. Even though I will focus on modern technology and social impacts this analysis could have been done at any point in the innovation timeline with similar results.

The majority of consumers rely on companies to produce easy-to-use, affordable products. The introduction of these feature-rich products allows consumers to be creative with their uses and, in turn, shape the industry – and sometime our entire society. I will discuss some of the products available to consumers and point out how they have affected the way people approach the art and science of photography. I will also present some research data that gives us a view into the societal impact some of these products and services have had and where the trends are currently leading.

When talking about customers in photography it is important to point out that there are several categories people may fall in. From a creation stand point, professional photographers, those generating income from their work, are at the top. Even within that group there are numerous tasks that require significantly different tools and equipment. The next level down is the prosumer market. This group consists of serious hobbyists that want near-professional quality with a largely reduced price tag as most will never recover their financial investment directly. Lastly, the consumer group includes entry-level hobbyists and those just seeking a photographic capability. These sectors do not

always move in the same direction, and it is important to companies to monitor their entire market space and adapt as needed.

MODERN TECHNOLOGY

In this section I will discuss the products and services available to consumers in the photographic market. I will talk about some of the technological capabilities, prices, and features available to all of the customer categories.

Products

When looking at photographic products we must consider the entire spectrum, from the many components of capture devices, to the several methods for display. Also, since photography by definition is capturing images using light, we must consider lighting products as well.[42] We will start by first considering the most necessary item – the camera.

Modern cameras capture and store images using digital technology. Still, film technology is not extinct and there are a few modern cameras still being sold using film as a recording medium. A film camera like the Nikon F6 shown in Figure 15, has implemented many modern innovations, but retains film as the recording medium. Due to the inclusion of several modern features, the price for the camera is still fairly high at $2,810 MSRP.[43]

[42] Photography; *Dictionary.com Unabridged*
[43] Nikon; *F6*

Figure 15: Nikon F6 (Nikon; *F6*)

Since it is not practical to discuss every camera on the market, I will summarize my findings by focusing on the top two vendors, Canon and Nikon. The information in Table 1 is a summary of the available equipment and the corresponding MSRP. I have chosen to discuss the digital SLR cameras in more detail than the compact digital cameras as the variation in price and feature set is much larger. I will summarize my findings for compact digital cameras as the product space is much larger.

	Vendor	Model	Est. Price
Flagship	Nikon	D3X	$7,999
	Canon	1Ds Mk III	$6,999
	Nikon	D3S	$5,199
	Canon	1D Mk IV	$4,999
	Canon	1D Mk III	$3,999
High-End	Nikon	D700	$2,699
	Canon	5D Mk II	$2,499
	Canon	7D	$1,699
	Nikon	D300S	$1,699
Midrange	Nikon	D7000	$1,199
	Canon	50D	$1,099
	Canon	60D	$999
Entry-Level	Canon	Rebel T3i	$899 *
	Nikon	D90	$899
	Nikon	D5100	$899 *
	Canon	Rebel T2i	$799 *
	Canon	Rebel T1i	$749 *
	Nikon	D3100	$699 *
	Canon	Rebel XSi	$649 *
	Nikon	D5000	$629 *
	Canon	Rebel T3	$599 *
	Canon	Rebel XS	$549 *
	Nikon	D3000	$499 *

*Camera includes kit lens

Table 1: Current Canon and Nikon Digital SLR Camera Lineup[44][45]

[44] Canon; *Digital SLR Cameras*
[45] Nikon; *Digital SLR Cameras*

As you can see in Table 1, prices range from around $500 all the way up to $8,000. You are likely wondering what the difference is between the cameras to yield such a wide disparity. One of the main differences is the image sensor. Most of the flagship and high-end cameras have a full-frame, 35mm, sensor; many of lower-end models have a cropped sensor. The higher end cameras typically have a high pixel count, which is useful for printing large images, and they may have faster shutter and continuous shooting speeds and more advanced light metering and autofocus systems.

I currently own a six year old entry-level digital SLR and the Canon 7D. With my 7D I am able to take continuous shoots at approximately eight frames per second. This feature is quite enabling when shooting action or unpredictable situations. Due to the digital recording medium, there is no additional cost for taking those shots other than the time it takes to sift through them. The entry cameras tend to be closer to four fps, but still use a similar 18 megapixel sensor like my 7D.

Modern digital cameras record images on solid-state memory, typically SD or CF memory cards. Consumers have been enabled in this space as well with prices falling and memory space increasing. I recently purchased a 4GB SD card for Canon S95 compact digital camera. The card was under $10 and will hold anywhere from 2,000 to 40,000 images depending on size and quality. Even the high speed 4GB CF memory card I got for my 7D will hold over 1,000 images at medium size/quality and was under $20. It is important to remember that this memory is reusable and quickly interchangeable for those shooting thousands of pictures. This enabling drop in memory prices has also affected long term storage for digital images. I also recently purchased a 1TB external hard drive for under $100.

If you were to shop for a compact digital camera, you would find yourself trying to narrow down your search from the over 100 choices. Compact digital cameras come

in all shapes, sizes, and colors. They have a range of features and range in price from under $100 to upwards of $500. There are many useful features loaded in these cameras and offered to consumers including: red eye reduction, face and blink detection, elementary image editing, wireless image transfer, and even GPS for image geotagging. Modern photographers have also been enabled with rugged cameras like the one shown in Figure 16 which boasts features like waterproof, cold resistant, and shockproof.[46]

Figure 16: Canon PowerShot D10 (Canon; *Digital SLR Cameras)*

Both compact digital camera owners and digital SLR owners have begun to enjoy both video and audio recording as well. Many of the cameras will record at High Definition (HD) and manufacturers have begun including a second microphone allowing native audio capture in stereo – this is seen in my Canon S95. My Canon 7D includes a connection port for an external microphone as well as an HDMI output port for external display. The video capture technology has progressed so far in these cameras that even videographers are using them to shoot movies.[47]

[46] Canon; *Digital SLR Cameras*
[47] Quezada-Dardon, R.; *SHUTTERBUGS*

Another key part of the image capture process is optics. Many consumers choose to purchase a digital SLR camera because it has the ability to change lenses. This is something I often take advantage of and most photographers find themselves always wanting more lenses. The downside of this feature is that lenses are not cheap. Camera manufacturers realize that many consumers invest more in the lenses than in the camera; therefore, most manufacturers avoid changing the lens mount design on their cameras or find a way to make them backwards compatible.

The main aspects that describe a lens and help determine both its price and purpose are focal length and aperture. Focal length, often thought of as "zoom", can vary from very wide as seen in Figure 17, to telephoto, as seen in Figure 18. Lens prices vary widely from a couple hundred dollars to over $10,000 and take into account other features such as focusing mechanisms, weather-sealing, lens quality, and image stabilization.

Figure 17: Rockefeller Center (taken by author)

Figure 18: Indy (taken by author)

Image stabilization is an innovation that has significantly improved the clarity of many photos taken in less than ideal situations. In most cases, the lens has a floating element that is altered using electromagnets when piezoelectric sensors detect movement.[48] This allows the lens to actually compensate for a notable amount of hand-shake during both video and still photography. This technology has spread to the compact camera market and is present on my Canon S95.

As I mentioned before, there are also several support products that have enabled photographers to expand their abilities. Things like rugged, weather-proof camera bags, and light, highly-collapsible carbon fiber tripods have enabled photographers to take their equipment almost anywhere. Even the introduction of consumer-grade nickel-metal

[48] Wikipedia; *Image Stabilization*

hydride (NiMH) rechargeable batteries had a large impact on photography with its improvement over nickel-cadmium (NiCd). These batteries are particularly useful for external flash units – also called strobes.

As lighting is so important to photography, several lighting products were improved to enable consumers to achieve near studio-quality lighting on location with small flash photography. Instead of carrying around large power packs and studio strobes, many photographers are taking advantage of the advancements and lighting power available in consumer-grade external flash units – including professionals! Entry units are under $200 and more advanced units cost around $500. Canon recently released the Speedlite 320EX which is the first consumer strobe to incorporate LED technology. The power of small flash photography can be seen in Figure 19 where photographer Joe McNally used about 9 consumer strobes controllably pulsing over a multi-second exposure to capture an amazing image of a ballet dancer.

Figure 19: Dance by Joe McNally (Nikon; *Joe McNally: Repeating Flash Lighting Technique*)

Software products have also been a large source of enablement for consumers. There are several popular programs for image editing and they are adding more and more features each year. Adobe released the content-aware tool as part of Photoshop CS5, which allows users to remove items from a picture by simply selecting the item you wish to remove. The algorithm determines what the picture might have looked like if the item weren't there and compensates for it as seen in Figure 20.

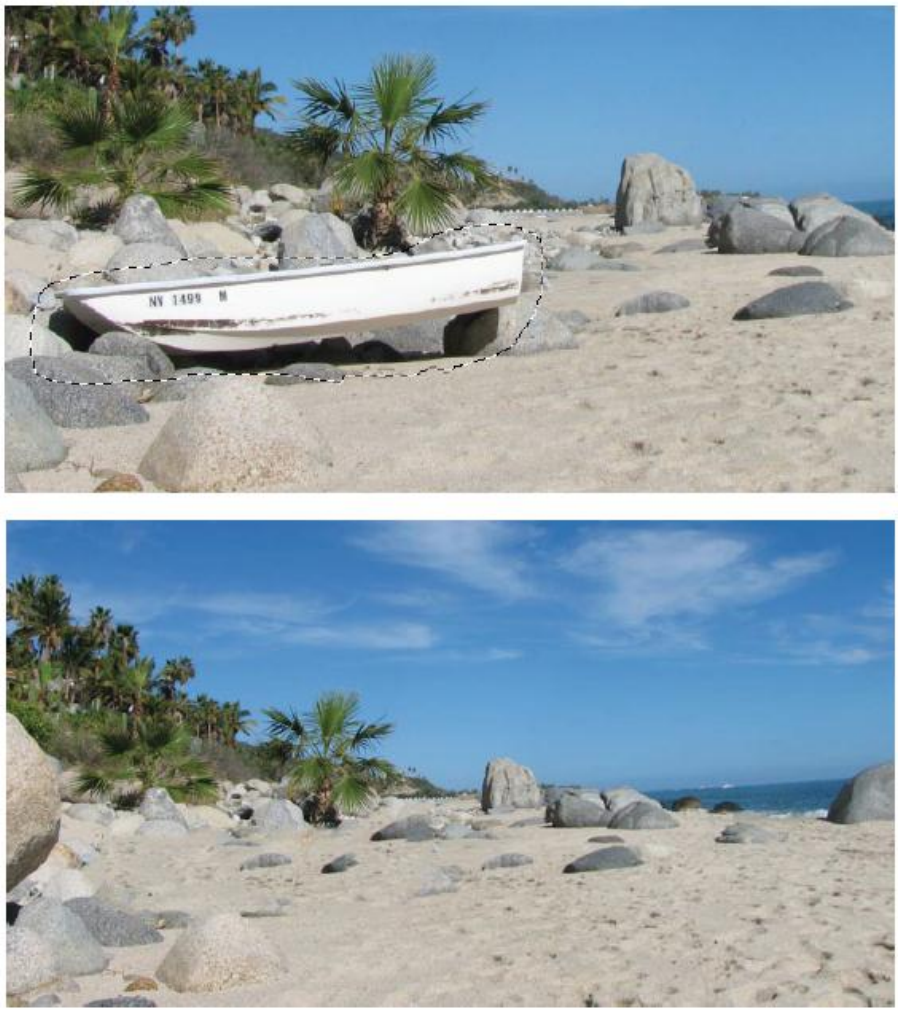

Figure 20: Content-Aware Tool in Photoshop CS5 (Chastain, S.; *Best of the New Features in Photoshop CS5*)

Photographic development has gone from chemicals in the darkroom for film, to software such as Adobe Photoshop Lightroom for digital images. Lightroom is loaded with features to help the consumer generate excellent digital photographs. Capabilities such as noise reduction, image watermarking, perspective correction, tethered shooting, and lens correction have given the consumer the tools needed to create stunning images. Lightroom also serves as a photo management tool making it easy for consumers to import new photos, and more importantly, export and publish photos for sharing with others.

Services

As the photographic products have evolved to better enable consumers, the supporting services have also adapted to provide users with a faster, more convenient photographic experience. As digital photography became more popular, many services began focusing towards the online community. The ease of information exchange online was a clear platform for photographic service providers and a desired platform for consumers.

Image and video hosting/sharing sites such as Flickr began offering free content hosting allowing users to share content with friends and family regardless of their location. Other users took the opportunity to share their images with the world to express themself or garnish constructive feedback from their peers. Social networking sites, such as Facebook, also began offering a native capability to post and share images and videos, further expanding their online presence.

Prosumer and professional photographers hoping to generate income from their work were enabled by online stock photography agencies. Websites like Shutterstock allow users to post their photos and videos in a license controlled environment where

people and companies can purchase a license to use the photo. The submitter is then paid for each download of their photo based on a pricing scheme. Some photographers become professional stock photographers and are able to make a nice living off the income they receive from these types of sites.[49]

Another service that has enabled consumers is online photograph submission for printing. These types of services range from extremely high quality printing, to instant prints at your local retail store. Similar to take-out food, customers can place their order for prints and upload the digital images online. Then, when they show up to the store, the prints are waiting. This eliminates the need for customers to bring their camera or memory device into the store hoping that the machine will support their device type. This also keeps the customer from having to process their images in the store, or worse, wait in line for the machine while someone else does.

An extension of this type of online photo submission that is becoming popular is the ability to create hardback photo books. I first saw this when newlywed friends had a photo book made of their wedding. I thought this was a great idea and began looking into the consumer options. I quickly found several online options such as Snapfish and Shutterfly. My wife and I rarely print single images anymore. Instead, we take all of the photos from a calendar year and pick out a representative sample to make a photo book, rather than a photo album. We also use this technique for special events that warrant an entire book, and more recently, we have begun giving these away as gifts to people. Outside of photo books, consumers have been given options to make cards, stationery, and calendars as well.

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[49] Arcurs, Y.; *Who?*

Finally, consumers have also been enabled by digitizing service companies. These companies will accept nearly all forms of media and transpose them into a digital format. Customers can take advantage of the many digital services already mentioned after they use this process for slides, negative, movie film, video tapes, etc. These services can digitize your previous work, and they can take advantage of modern technology to correct for limitations in the original recording medium or the effects of aging. Many customers also take advantage of these services to eliminate extraneous playback devices and help organize large collections of prints, film, and slides.

SOCIETAL IMPACT

The availability of the products and services discussed above has lead to a strong embracement of digital photography. It is now easier to capture, manipulate and publish digital images than it has ever been before. This phenomenon has lead to a change in the number of photographic participants as well as the way they engage in photography. InfoTrends, a market research and strategic consulting firm, summarizes this finding while discussing internet imaging trends:

> InfoTrends projects that the total number of online photo service users will approach 110 million by 2012. This growth will be driven by factors including the ubiquity of broadband access, the availability of more sharing features that appeal to moms and other family memory keepers, high penetration of digital photography, and improvements that have facilitated the photo-uploading process.[50]

My research showed that it is important to consider all types of cameras, including those embedded in other devices. Not surprisingly, cameras integrated into cell phones have had a dramatic impact on the camera market. Digital marketing intelligence firm comScore reports in a recent press release that 33% of U.S. cell phone customers

[50] InfoTrends; *Internet Imaging Trends*

have a smartphone; moreover, that number is growing and many modern "dumbphones" also include cameras.[51] InfoTrends echoes this data and projects smartphone shipments to increase to over 1 billion handsets worldwide by 2015 and a camera phone penetration of nearly 2 billion handsets.[52]

This increase in camera phone ownership begs the question: are people using the cameras included with these phones? My research indicates that the answer is not only 'yes', but that their use has an inherent societal impact. One example was presented by National Public Radio (NPR) blog host, Mark Memmott. Memmott was reporting on the termination of the once popular Flip video camera by Cisco systems. This discontinuation seemed to be an acknowledgement of the fact that even digital video has significantly migrated to phones.[53] This is also a good example of the agility needed in this market space as Cisco had invested $590 million only two years before when it purchased Flip owner, Pure Digital Technologies.[54]

Also in April 2011, NPR contributor Eyder Peralta wrote an article indicating that the iPhone 4 was nearing the top of the "most popular camera" chart on the Flickr photo-sharing website.[55] I decided to check the standings before finalizing this paper and sure enough, Flickr is reporting that the Apple iPhone 4 is the most popular camera in the Flickr community.[56]

While reviewing the camera data on Flickr, I also noticed another interesting data point. Of the top five cameras listed, none of them were in the "point & shoot" camera

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[51] comScore; *comScore Reports May 2011 U.S. Mobile Subscriber Market Share*
[52] InfoTrends; *Worldwide Camera Phone Installed Base to Near 2 Billon by 2015*
[53] Memmott, M.; *The Flip Flops: Smartphones Helped To Kill The Little Video Camera*
[54] Memmott, M.; *The Flip Flops: Smartphones Helped To Kill The Little Video Camera*
[55] Peralta, E; *iPhone 4 On Track To Becoming Flickr's Most Popular Camera*
[56] Flickr; *Most Popular Cameras in the Flickr Community*

category; rather, the rest were all digital SLR cameras.[57] After further research, it seems that the market had been trending that way for the last few years. InfoTrends made the following observation in a publication release in October 2008:

> Point and shoot (P&S) cameras are headed toward commodity status and are under constant price pressure, while digital SLRs (DSLRs) are emerging as an area of growth within the industry. Once relegated to professional photographers or serious hobbyists, DSLRs have come down in price over the last several years, making them affordable to a greater number of people and attractive to those who never would have purchased a film DSLR.[58]

SUMMARY

It is clear that the relationship between consumer innovation and customer enablement is tightly coupled. As consumers innovate and turn their creative ideas into public demand, companies respond with products and services that both enable consumers and generate profits. When all of those things come together, the social impact can be huge. The inclusion of cameras in phones is a prime example of how a seemingly small change in technology, when embraced by customers, can cause a large ripple in an entire industry and even dramatically change the way consumers behave.

[57] Flickr; *Most Popular Cameras in the Flickr Community*
[58] InfoTrends; *The Consumer Digital SLR Marketplace: Identifying & Profiling Emerging Segments*

Chapter 4: Do-It-Yourself

Overview

I have talked about consumer innovation and customer enabling and what a substantial impact they can have on an industry. In this chapter, I will present another element that is having an impact in photography, the Do-It-Yourself (DIY) mentality. Some consumers are leveraging enabling technologies from tangential fields and decreasing their need for retail photographic products.

Instead of innovating and submitting ideas to large companies to produce, customer have been taking matters into their own hands and producing the items themselves. Consumers have also found a wealth of information online enabling them to learn from their peers for free. Software developers will also donate significant amounts of coding time to develop free or low cost software applications. This DIY is one more example of the reduction in the gap between consumers and producers.

Innovator to Producer

To say that the internet has changed our society is an understatement. The ability to exchange information quickly and easily has been momentous in nearly every industry, and photography is certainly included in that. One major influence in modern photographic trends is the increased availability to photography education resources.

I discussed earlier how easy it is to post photographs to a site like Flickr for community review and criticism. This type of feedback can be extremely helpful and motivating. Consumers may get advice on how to improve, or praise for a job well done. Furthermore, this feedback may come from observers or peers, and now, even professionals.

Some of these professionals are satisfying their mentoring desires by creating websites and blogs dedicated to helping others have a better photography experience. Some sites are broad and contain tips, training, equipment reviews, and even assignments. Others are very specific and focus on one particular area, or type of photography. One of my favorite sites is the "Strobist" blog, which is dedicated to sharing lighting techniques.[59] In particular, David Hobby of Strobist tends to focus towards small flash photography which is cheaper and more flexible than large studio strobes.

There are so many resources online that a consumer can become quite proficient at photography without ever purchasing a book or attending formal training. Whether you have general questions about lighting or image editing, or specific questions about how to use a particular feature on your camera or software, the answers are online in some form. Video has become increasingly available and easy to produce, that many site owners post video-based lessons. You can essentially go to school for photography without ever leaving your home or paying a dime.

You might think that the availability of so many free resources has had a negative impact in the profitability of the photography industry, but that is not true. Instead, amateurs have been enabled and motivated to join a thriving community. This effect can be seen with the increase in DSLR cameras mentioned earlier. Consumers are trending towards more photographic materials and are demanding higher quality. The industry continues to experience modest growth, though InfoTrends notes that, "…manufactures will face challenging years as they look for ways to increase profitability and sustain income."[60]

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[59] Hobby, D.; *Strobist*
[60] InfoTrends; *Digital Photography Trends - U.S.*

The magnitude of power a group of people can have in a networked world can be quite impressive. This power can be observed by reviewing the effects of crowdsourcing. Companies outsourcing work to the general public can experience increases in solutions to difficult problems and in overall profit margins. Companies like InnoCentive are leveraging these concepts by offering an open innovation and crowdsourcing marketplace. Problem solvers have an opportunity to solve significant challenges and take home a cash prize, while companies can decide how much a solution is worth to them and outsource the problem solving to the brainpower of the collective community.[61]

The effects of crowdsourcing in photography were seen with the introduction of microstock photography websites like the site ShutterStock I mentioned before. The introduction of these types of sites was polarizing to the community. While amateurs found a way to make a few extra bucks and companies enjoyed the increase in options and decrease in price, professional stock photographers had their legs chopped out from under them. Many professionals who once charged over $100 per photograph were now competing with similar images licensing for a few dollars.[62]

What about crowdsourcing in videos? The popular video hosting website YouTube is a great example of video-based crowdsourcing. Users enabled with consumer video cameras record content and post it for gratis consumption. This content has been used for many things, one of which is an entire TV show called Tosh.0 starring Daniel Tosh.[63] Although Tosh adds his comedic value, the show is basically a collection of viral video clips, more importantly, clips that Comedy Central did not have to shoot.

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[61] InnoCentive; *InnoCentive*
[62] Howe, J.; *The Rise of Crowdsourcing*
[63] Tosh, D.; *Tosh.0*

While these are just a few examples, it is clear that there is more to consider than just consumer innovation of customer enabling. Consumers are now regarded as innovators, customers, and producers. The gap between professional and amateur is shrinking, providing opportunities for companies and demanding that professionals find a way to stay relevant.

DID-IT-MYSELF

In order to fully represent the impact DIY can have in a community, I decided to immerse myself into the photography DIY world and actually partake in a few of the activities and share my results. I will preface this work by reminding you that I am an Information Security Engineer, not a professional photographer. These projects are geared towards hobbyists and do not require advanced knowledge.

I started by accessing the Strobist blog site and looking for a project that would represent something many consumers would be interested in. I settled on constructing a macro photo studio, also known as a light tent or light box, using the guide posted by Hobby.[64] Unfortunately, I disposed of the final product during my relocation from Texas to Maryland and forgot to capture a photo of the completed box. Figure 21 is from the Strobist guide and looks nearly identical to my creation.

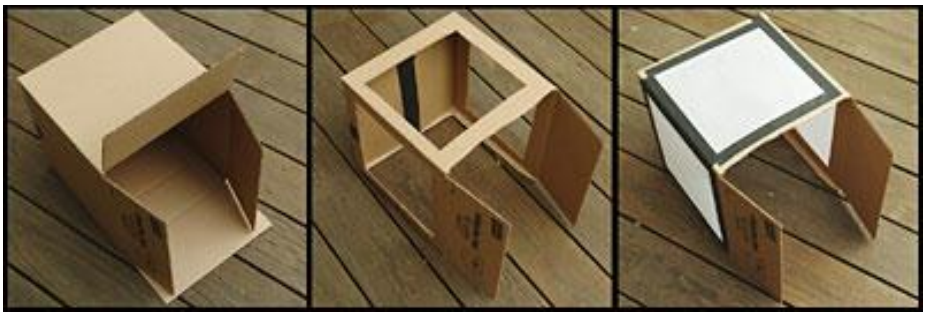

Figure 21: Macro Photo Studio (Hobby, D.; *How To: DIY $10 Macro Photo Studio*)

[64] Hobby, D.; *How To: DIY $10 Macro Photo Studio*

While the title of the guide indicated that the cost would be about $10, I found that by reusing items I already had I was able to make it for a few dollars. I searched around for a comparable retail product and was unable to find one for sale under $15. Reusing an old box, I cut out the panes as indicated in the guide and covered the area with parchment paper to diffuse the light. After taping everything down, all that was left was to insert a piece of poster board and setup my camera and lights.

At the time I did not have an off-camera flash system, so I grabbed a nearby lamp and used continuous lighting to expose my image. I used a piece of bent, white art paper to create a continuous background and shot a picture of my telephoto lens. The picture I took is shown in Figure 22; I believe it turned out well. I quickly found myself grabbing objects from all over the house and using the new macro studio to photograph them. I was excited to have this new technique available to me, and at such a low cost. I would have never purchased a retail light tent, but did appreciate the soft light capability it produced. This versatile setup can be used by amateurs posting items for sale on eBay, or professionals taking pictures for advertisement companies – box size is the only limit.

Figure 22: Telephoto lens in light box (take by author)

A few months ago I decided to invest in an external flash unit. I noticed that when I used the flash indoors and mixed it with incandescent light, I was unable to achieve a proper white balance. I did some research on the Strobist site and found another DIY article addressing this issue. Since the flash unit has one color temperature, you must use a lighting gel to adapt the flash temperature to the available light source.[65] For a few dollars, I purchased a Rosco gels sample pack – while these samples do not fit a traditional stage light, they do fit perfectly on a flash unit. I extended the length with gaffers tap and used adhesive Velcro to make an interchangeable system as seen in Figure 23. I also affixed the loops side of the adhesive Velcro to my flash unit; this can be used to attach various modifying items. In Figure 24, you can see a comparison with gels attached to my flash. The green gel on the left is used to correct for fluorescent light and the orange gel is used to correct for tungsten light. This DIY project was easy and only cost a few dollars; besides, the output is necessary for any serious photographer.

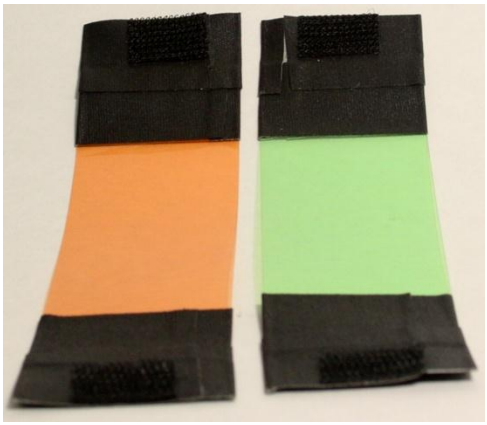

Figure 23: Flash Gels (taken by author)

[65] Hobby, D.; *Lighting 101: Using Gels to Correct Light*

Figure 24: Flash Gel Comparison (taken by author)

I found that most of the DIY projects not only created helpful tools, they were fun to complete. Therefore, I decided to pick one more DIY project from the Strobist site to show how consumers can create retail items at home. I chose to go with another light modifying device for my external flash – a snoot. The function of a snoot is to block the light from all directions except where the flash is pointed. This effect can be seen in two of the pictures provided in the snoot how-to guide.[66] In Figure 25 you can see a fairly wide spread of light as the flash is bare. In Figure 26, an 8" snoot is attached to the flash yielding a much narrower beam.

[66] Hobby, D.; *Lighting 101: Cereal Box Snoots and GoBo's*

Figure 25: Bare Flash (Hobby, D.; *Lighting 101: Cereal Box Snoots and GoBo's*)

Figure 26: Flash with 8" Snoot (Hobby, D.; *Lighting 101: Cereal Box Snoots and GoBo's*)

I did some research to determine how much a retail snoot would cost and the average price seemed to be about $30 – the Strobist article only called for a cereal box and some tape. I grabbed a cereal box from our recycle bin and my gaffers tape and cut out a tube to fit my flash. You can see my final product in Figure 27; note that I put white paper on one side and black gaffers tape on the other. The snoot is reversible and using the white side will give softer edges, while the black side will give light with hard edges. This project is basically free and again, provides a piece of useful equipment.

Figure 27: Snoot (taken by author)

SUMMARY

The DIY community for photography is extensive and very active. While the Strobist blog focuses mostly on lighting, other sites like DIYPhotography.net have a substantial amount of content and a more holistic scope. The DIY projects left me better equipped and cost very little money. There is a time investment, but after having done it,

I believe that most enthusiasts would enjoy both the finished product and the construction process.

As consumers gain increased access to equipment and ideas, these DIY projects become more feasible. Instead of trying to fight the crowd, companies should look for opportunities to leverage the situation and provide customers with products and services in an agile manner. Like it or not, our society is becoming more and more networked and the power is shifting to the consumer and the crowd.

Chapter 5: Recommendations and Conclusions

RECOMMENDATIONS

There are a few recommendations I would suggest based on my research on this topic. Most importantly, I would emphasize the rapid pace at which the photography field is changing. This is true not only in the technology, but in the community supporting the discipline. That being said, I would recommend that research continue in the area of digital photography trends. This data will be extremely useful to sales, marketing, and advertising departments.

Given the success of crowdsourcing, I would also recommend that companies look for ways to incorporate the "crowds" in their problem solving efforts. While some people may be motivated by money, companies might find creative incentives to motivate consumers to contribute. I would recommend that companies also take this approach with product/service innovation. Companies should look for ways to harvest consumer ideas and trend data to improve products and continue to stay flexible in the market place.

Additionally, I would recommend further research into the societal impacts of the changes in photography. Many of these are related to changes in other areas such as social networking and smartphones. There may also be societal impacts related to areas like stock photography. Future observation and research may answer the question: Will microstock hurt professional stock photography? Is there room for both? I would also recommend research in related areas such as digital graphics design as the same phenomenon is quite likely.

CONCLUSIONS

So, what is the answer to the original research question of, "how do consumers drive innovation in technological markets?" After my research, I still believe it is difficult to answer quantitatively, but I have tried to highlight some interesting findings.

By reflecting on the innovation timeline, we can clearly see that consumers can not only substantially impact existing products; they are capable of innovating entire technology areas that may drastically alter the industry. When the Knoll brothers developed the Photoshop software, they not only provided new capabilities at the time, they also impacted generations of artists and photographers. What is more, their innovation affected the whole of society as "photoshop" is recognized as a transitive verb in the dictionary, "to alter (as a digital image) with computer software."[67]

The innovation timeline also showed us how quickly the field progressed and how necessary adaptation is. I can easily conclude that the power of consumer-driven innovation is considerable and that those companies that embrace it can find success. However, it was also clear that those companies that fail to adapt will struggle and hallmark names, such as Polaroid, may find themselves bankrupt.

The companies that do adapt and provide the consumers with the products they demand will not only find financial success, they will also find themselves shaping an industry. It was clear how the introduction of products targeted at the consumer market could impact society in numerous ways. As the barrier to entry shrank, so did the gap between the professionals and the amateurs. This has created an interesting dynamic and I believe the impact is not completely realized at this time. My research does conclude that photography is still growing, but the companies must pay close attention to the trend data in each subcategory.

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[67] Merriam-Webster; *photoshop*

I can also conclude that the DIY community is active and participation is growing as non-professional consumers struggle to find extra funds for their photographic hobbies. The environment is extremely supportive and generally quite professional. The ease of information exchange coupled with online shopping can make individuals on the opposite side of the world interact and share experiences like neighbors.

In this thesis I used photography as a case study, but I believe the observations and findings in this paper can be applied more generally. I believe that consumer-driven innovation is a powerful force and can be used as an opportunity in many industries. Customer enablement clearly applies to numerous fields as we can see how technologies often couple together (like phones and cameras) and affect both the market place and society. Lastly, Do-It-Yourself (DIY) is obviously not a new concept; just visit your local Home Depot store. What is interesting about DIY is the spread to fields that are more technologically oriented as well as the increase in the depth of knowledge available with an increasingly networked world. The bottom line is: consumers are here and cannot be ignored – this includes their financial and intellectual capital, as well as their influential power in numbers.

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